



Wells-Gardner 19-Inch Medium-Resolution Color Video Display

Model 19K4915

Service Manual

This manual applies to displays with
serial numbers of 576001 and above.

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WARNINGS



Power-Up Warning

Before making any servicing or testing, make certain that you use an isolation transformer between the AC supply and the AC plug of the video display. The chassis and the heat sink are *directly connected* to one side of the AC line, which could present a shock hazard.

Before making any servicing, read all the precautions on the CRT and chassis.

X-Ray Radiation Warning

Parts which influence X-ray radiation in the horizontal deflection and high-voltage circuits, the picture tube, etc., are indicated by a star (★) in the parts list. When replacing these components, use **only** the type shown in the parts list.

High Voltage

This video display contains **high voltages** derived from power supplies capable of delivering **lethal** quantities of

energy. Do not attempt to service the video display until you have observed all precautions necessary for working on high-voltage equipment.

CRT Handling

Do not bump or scratch the picture tube because this may cause the picture tube to implode—resulting in injury. Shatter-proof goggles must be worn when handling the CRT. High voltage must be completely discharged before handling. Do not handle the CRT by the neck.

Product Safety Notice

For continued safety, replace safety-critical components **only** with manufacturer-recommended parts. These parts are identified by ▲ on the schematic diagram.

For replacement purposes, use the same type or specified type of wire and cable; make certain that you follow the positioning of the wires (especially for the high-voltage and power-supply circuits). Shock hazard, fire hazard, or video display damage may result if you use alternative wiring or positioning.

Specifications

Supply

Voltage	102–132 VAC
Frequency	50–60 Hz

NOTE

Apply supply voltage through an isolation transformer with 1 Amp. minimum capability.

High Voltage (EHT)

For 19-inch models 27.4 ± 0.8 kV at 0 mA Beam,
 23.6 ± 0.8 kV at 0.75 mA Beam

Note: Condition for above is that line voltage equals 120 V

Table 1 Video Display Adjustment Controls

MAIN PC BOARD

Vertical Hold Control, VR301
 Vertical Size Control, VR303
 Horizontal Hold Control, VR351
 Vertical Shift Control, VR901
 Horizontal Centering Adjustment Jumper (3 positions)
 Horizontal Shift Control, VR352
 Screen Control (Part of H.V. Unit), T352
 Focus Control (Part of H.V. Unit), T352
 Horizontal Size Coil, L352
 Black Level Control, VR201
 Vertical Damping Control, VR302

NECK PC BOARD

Video Drive Controls: Red (VR401), Green (VR402)
 CRT Cut-off Controls: Red (VR403), Green (VR404), Blue (VR405)

Control Adjustments

NOTE

Horizontal vs. Vertical: Some models have the picture tube mounted vertically rather than horizontally. That is, the picture tube is mounted in the frame such that the long dimension of the tube is up and down. Other than the physical orientation of the picture tube, there is no electrical difference between these models and their horizontal counterparts. The vertical circuits produce and control deflection along the short dimension of the tube in all models.

The horizontal circuits produce and control deflection along the long dimension of the tube in all models. Therefore, wherever “vertical” appears in this manual or on the video display, the word refers to the *short* dimension of the picture tube; wherever “horizontal” appears, that word refers to the *long* dimension of the picture tube.

1.0 Black Level Control

This control has been set at the factory to 100 VDC (see Figure 10) and should not need further attention. However, when a game is connected to the video display, you may have to slightly adjust the screen control to obtain the proper black level (the black portion of the picture just extinguished).

2.0 Vertical Size (Height)

The location of this control is shown in Figure 1. If necessary, adjust this control slowly until the picture or test pattern has the correct vertical proportions.

NOTE

This adjustment interacts with the vertical damping adjustment described in the section below. You may have to readjust the vertical size after adjusting the vertical damping control.

3.0 Vertical Damping

You will have to adjust this control only if the video display is being used with a game in which the top several raster lines are visible on the screen. Adjust the vertical damping control for uniform spacing of the top raster lines.

4.0 Circuit Protection

A 4.0 Amp pigtail fuse is mounted on the Main Board. This fuse protects the power output circuit.

5.0 Focus

Adjust the focus control, located on the high-voltage unit (T352), for maximum overall definition and fine picture detail.

6.0 Horizontal Hold Control, VR351

You should allow a warm-up period of at least five minutes before aligning the video display. With the display being driven from the game signal, short TP601 to TP31. Adjust VR351 (see Figure 1) until the picture stops sliding horizontally. Remove the short.

7.0 Horizontal Video Position

If the video is off center on the raster, you can compensate somewhat by adjusting this control.

8.0 Vertical Raster Position

If the video is off center vertically, you can compensate somewhat by turning the vertical raster position control.

9.0 Horizontal Raster Position

If the video is off center horizontally, you can compensate somewhat by moving the horizontal raster position adjustment jumper to either position "R" or "L."

10.0 Horizontal Width

The horizontal width coil is adjusted with a hexagonal tuning tool. Adjust this control slowly, if necessary, until the picture or test pattern has the correct horizontal proportions.

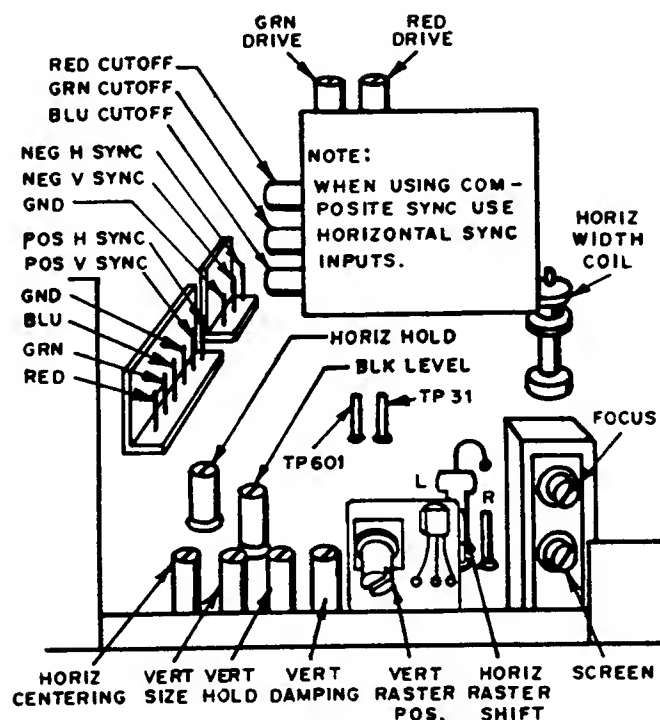


Figure 1

Servicing Adjustments

NOTE

After replacing any parts in the CRT assembly, you must make all five adjustments described in this section. Before making these adjustments, apply a suitable power source to the video display through an isolation transformer. Then apply a suitable signal source to the Main PCB through P201 and P202.

1.0 Degaussing

Summary: Demagnetize the shadow mask and all surrounding metal parts with an external degaussing coil.

All video displays are equipped with automatic degaussing coils (L701) that demagnetize the picture tube every time the video display is turned on after being off for a minimum of five minutes. Should any part of the chassis become magnetized, you will have to degauss the affected area with a manual degaussing coil. Move the coil slowly over the screen and over all surrounding metal parts. Then slowly withdraw the coil for a distance of 6 feet before turning off the coil.

2.0 Color Purity

Summary: Adjust the purity magnets and the yoke position to produce an overall uniform color.

NOTE

Purity and static convergence adjustments will interact. The video display must have been operating 15 minutes before you start this procedure.

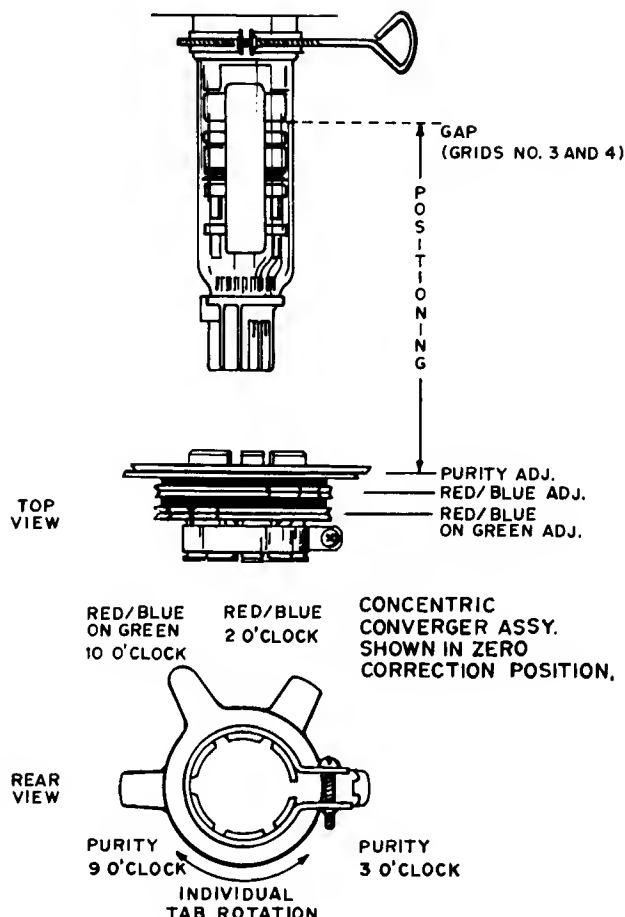
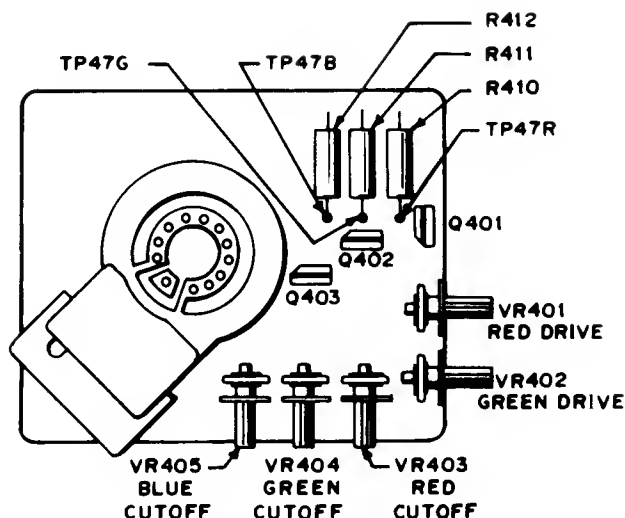


Figure 2

- 2.1 For best results, we recommend that the purity adjustment be made after the video display is placed in its final location. If the display must be moved, make this adjustment with it facing east or west.
- 2.2 Set the converger assembly on the CRT neck with the centerline of the purity adjustment magnet over the gap between grids no. 3 and 4 (see Figures 2 and 6).
- 2.3 Make certain that the magnetic ring pairs are in their correct positions before starting this procedure. This produces a zero-correction condition on the CRT beam and helps you make adjustments.
- 2.4 Make certain that the vertical raster position control is at the center of its rotation.
- 2.5 Remove the R/G/B signal from the video display.
- 2.6 Turn the green cutoff control (VR404) on the Neck Board fully clockwise (see Figure 3).
- 2.7 Turn the the red and blue cutoff controls (VR403 and VR405) fully counterclockwise.
- 2.8 Pull the deflection yoke backward so that a green belt appears on the screen (see Figure 4).
- 2.9 Decrease the horizontal width of the raster, if necessary, to see the right and left edges of the raster.



**Figure 3 Neck Board—Component Side
(With Horizontally Mounted CRT)**

- 2.10 Move the two purity magnets with respect to each other to center the raster horizontally on the screen and the green belt on the raster horizontally.
- 2.11 Gradually push the deflection yoke forward; fix it at the place where the green screen becomes uniform throughout.
- 2.12 Turn the cutoff and drive controls. Confirm that each color is uniform.
- 2.13 If any color is not uniform, readjust it, moving the purity magnets slightly.
- 2.14 Turn all three cutoff controls fully counterclockwise. Slowly turn the red cutoff control up or clockwise until a red raster is just barely visible.
- 2.15 Slowly turn up the green and blue cutoff controls so that their associated colors, mixed with the red, result in a white or grey raster.
- 2.16 Make certain that the white or grey color is uniform throughout the screen.
- 2.17 Insert a wedge temporarily as shown in Figure 4; adjust the angle of the deflection yoke.

3.0 Static Convergence

Summary: Converge red and blue on green in the center of the screen.

- 3.1 Connect a crosshatch signal or grid pattern to the video display.

- 3.2 A pair of 4-pole convergence magnets is provided to converge the blue and red beams (see Figure 6). When the pole opens to the left and right 45° symmetrically, the magnetic field is maximized. Red and blue beams move to the left and right (see Figure 5). Vary the angle between the tabs to adjust the convergence of red and blue vertical lines.
- 3.3 Rotate both 4-pole convergence magnet tabs as a pair to adjust the convergence of the red and blue horizontal lines.
- 3.4 A pair of 6-pole convergence magnets is provided to converge the magenta (red + blue) to the green beams (see Figure 6). When the pole opens to the left and right 30° symmetrically, the magnetic field is maximized. Red and blue beams both move to the left and right (see Figure 5). Vary the opening angle to adjust the convergence of magenta to green vertical lines.
- 3.5 Rotate both 6-pole convergence magnet tabs as a pair to adjust the convergence of magenta to green horizontal lines.

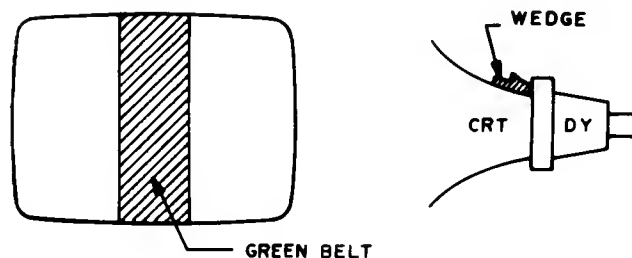


Figure 4

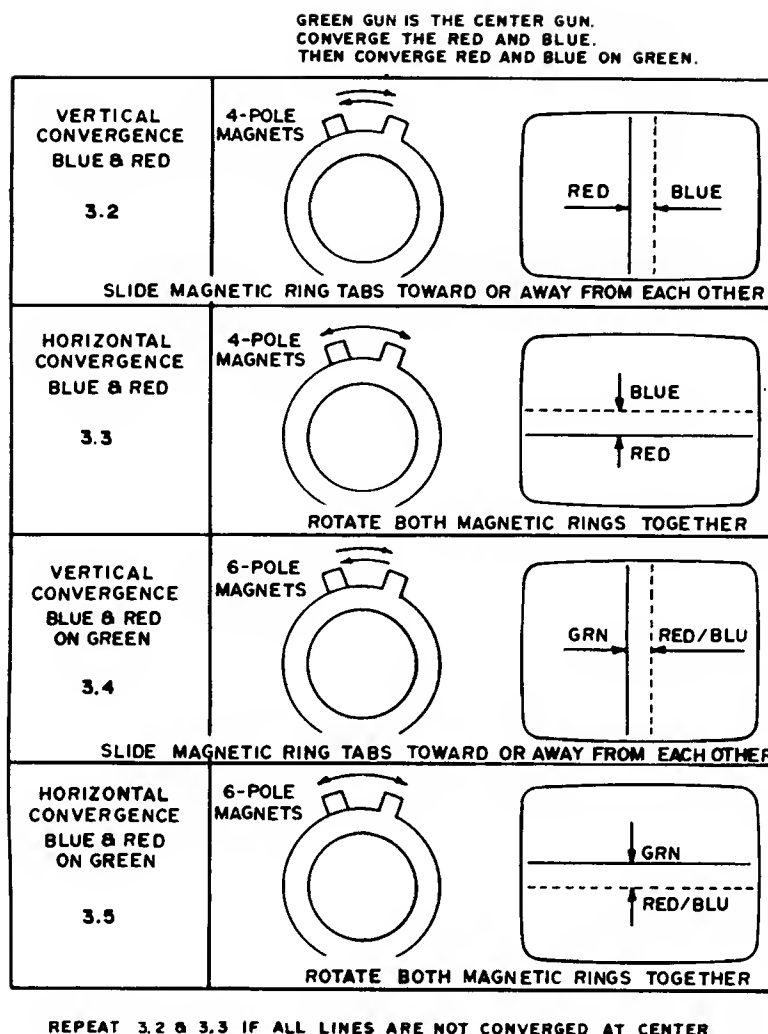


Figure 5

4.0 Dynamic Convergence

Summary: Converge red and blue at the edges of the screen.

- 4.1 Feed a crosshatch signal or grid pattern to the video display.
- 4.2 Temporarily insert a rubber wedge as shown in Figure 7.
- 4.3 Tilt the angle of the yoke up and down to adjust the crossover of both vertical and horizontal red and blue lines. See Figure 8 (a) and (b).
- 4.4 Tilt the angle of the yoke sideways to adjust the parallel convergence of both horizontal and vertical lines at the edges of the screen. See Figure 9 (a) and (b).
- 4.5 After you have positioned the yoke, insert three more rubber wedges in the positions shown in Figure 7. Do NOT force the permanent wedges in: insert the wedges until they just make contact with the yoke.
- 4.6 Fix the three permanent rubber wedges with chloroprene rubber adhesive.
- 4.7 After the adhesive has dried enough to hold the wedges in place, carefully remove the temporarily installed wedge.

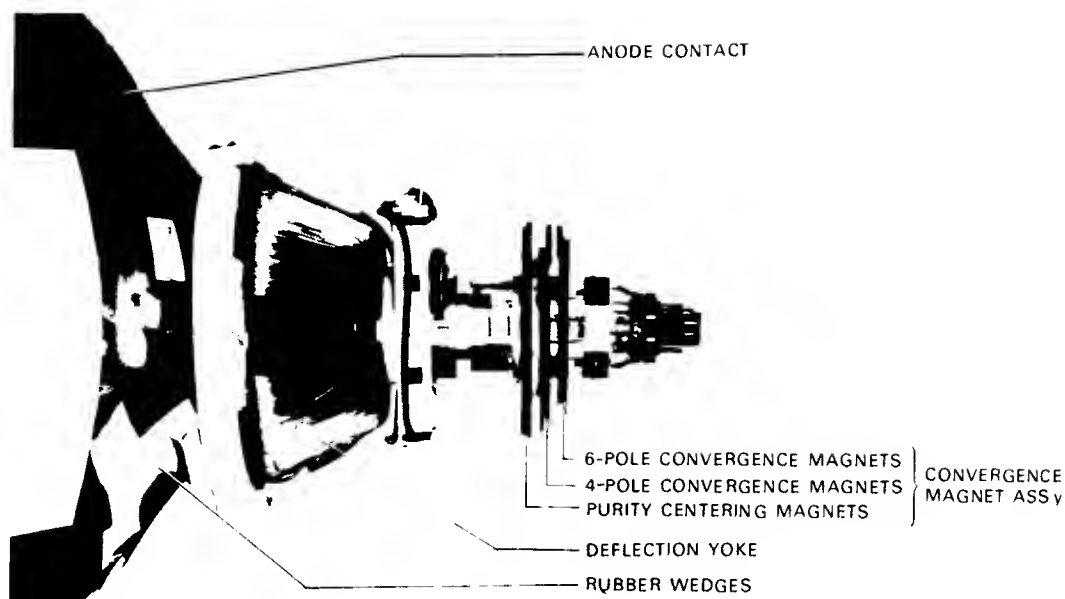


Figure 6

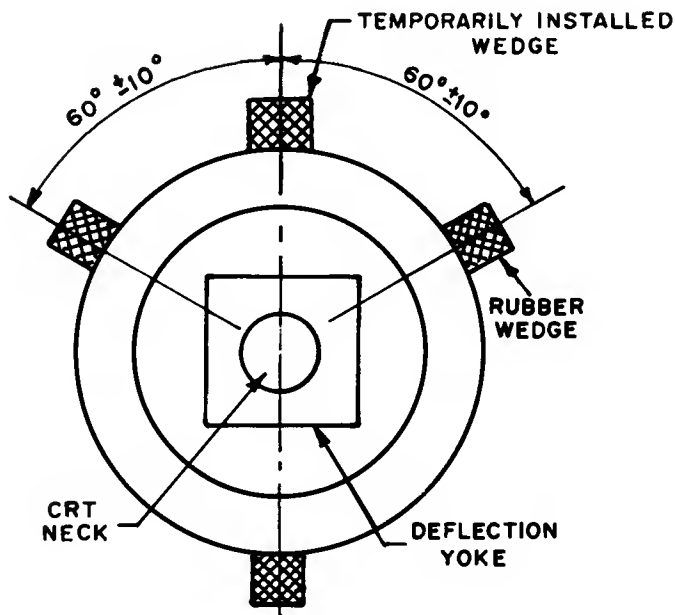


Figure 7

5.0 White Balance

Summary: Set the grey and white brightness tracking.

To adjust the white balance of the video display, you will need an oscilloscope with a DC-coupled mode in the vertical amplifier.

Refer to Figure 1 and 3 while doing the following adjustments in subdued light after degaussing and setting the purity of the CRT.

- 5.1 Ground the R/G/B video inputs.
- 5.2 Set the red and green drive controls, VR401 and VR402, to approximately 80% of fully clockwise rotation.
- 5.3 Set the screen and R/G/B cutoff controls to their minimum (fully counterclockwise) positions.
- 5.4 Connect the test equipment to the collector of a video output transistors (Q401, Q402, and Q403) on the CRT neck PCB at TP47R, TP47G, and TP47B
- (see Figure 3). Determine which color has the lowest black-level voltage. This is the lead color gun.
- 5.5 Adjust the black level control (VR201) of the lead color gun to obtain the waveform shown in Figure 10.
- 5.6 Slowly turn the screen control clockwise until the raster is just visible.
- 5.7 Adjust the screen control counterclockwise until the raster is just extinguished.
- 5.8 Connect a 1.5 VDC source to the R/G/B inputs. Then adjust the three cutoff controls for best grey uniformity.
- 5.9 Connect a 3.5 VDC source to the R/G/B inputs. Then adjust the R/G drive controls, if necessary, for best neutral white (7500° K).
- 5.10 Repeat steps 5.8 and 5.9 until you obtain good tracking of white balance.

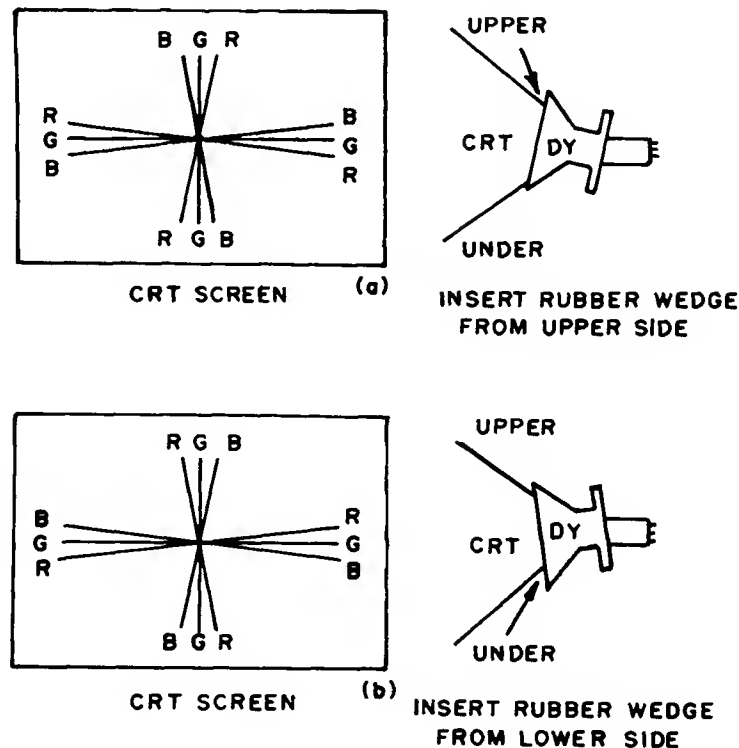


Figure 8

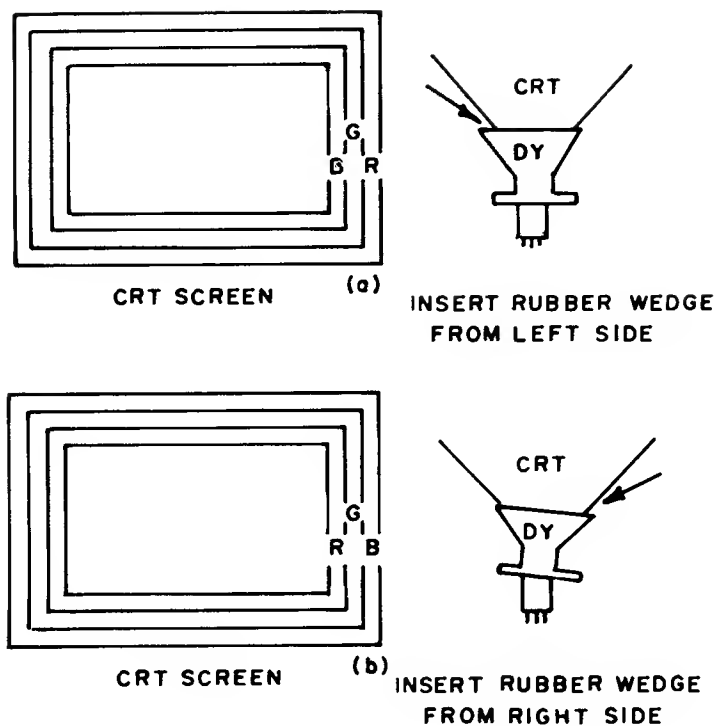


Figure 9

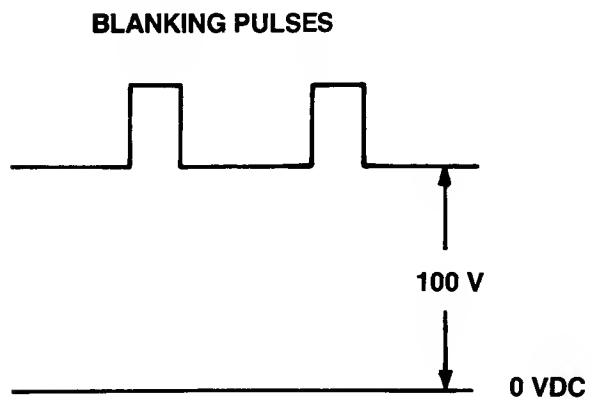
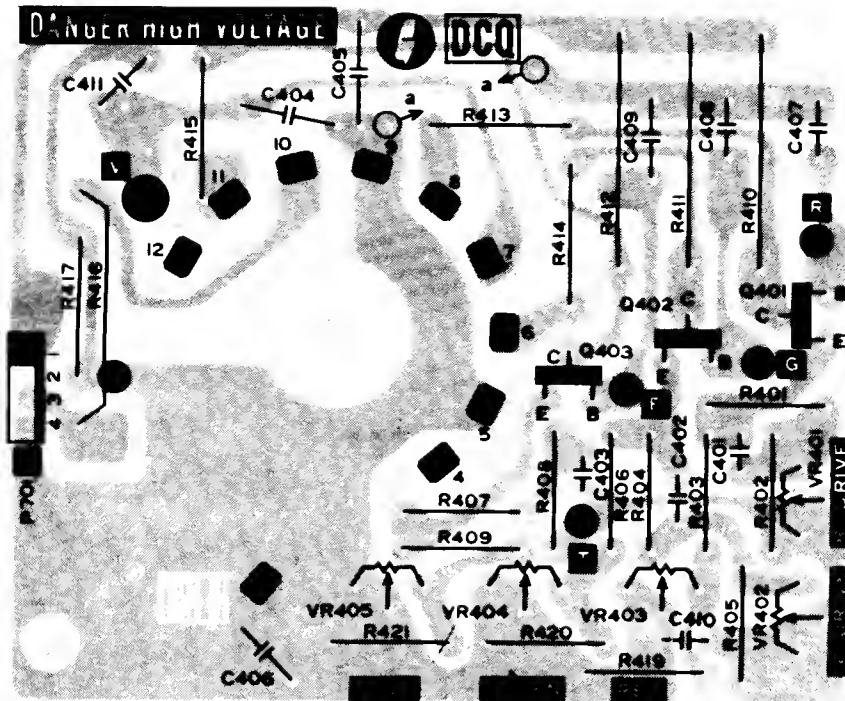
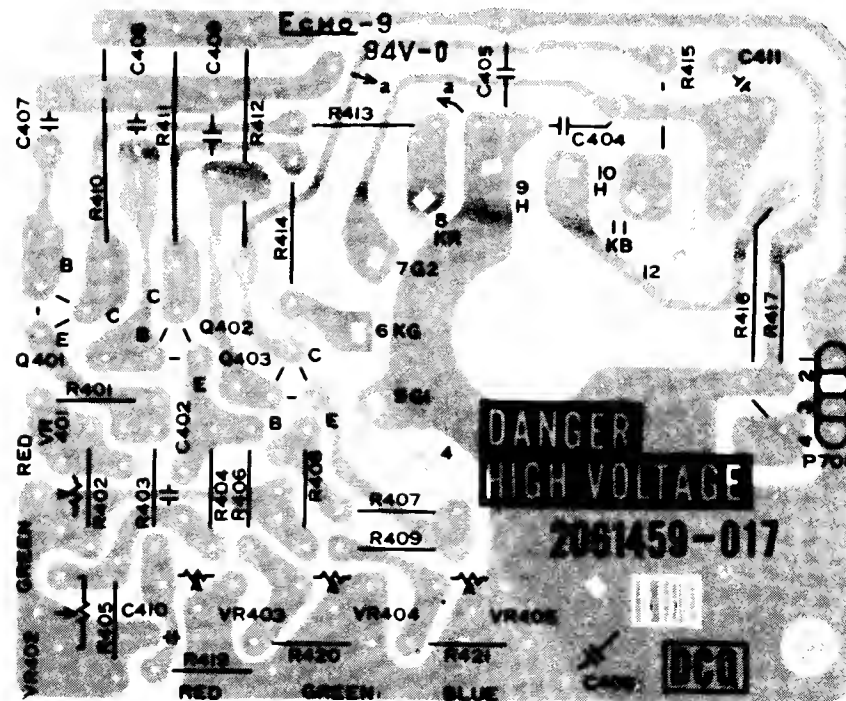


Figure 10



VIEW OF COMPONENT SIDE



VIEW OF FOIL SIDE

Neck PC Board

Parts List

This monitor contains circuits and components included specifically for safety purposes. The two symbols described below are used in the parts list to mark components that you should replace only with exact factory replacement parts. Using substitute parts may create a shock, fire, radiation or other hazard. Only qualified personnel should perform service.

- ★ indicates parts that influence X-ray radiation in the horizontal deflection and high-voltage circuits, the picture tube, etc.
- ⚠ indicates safety-critical parts

Main Board

Refer. No.	Wells-Gardner Part No.	Description	Refer. No.	Wells-Gardner Part No.	Description
Resistors			R229	203X6700-421	270 Ω , $\pm 5\%$, $\frac{1}{2}$ W Carbon
R201	203X6500-645	1 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon	R230	203X6500-863	8.2 k Ω , $\pm 5\%$, $\frac{1}{2}$ W Composite
R202	340X2680-934	68 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon	R231	203X6500-863	8.2 k Ω , $\pm 5\%$, $\frac{1}{2}$ W Composite
R203	203X6500-405	100 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon	R232	203X6500-863	8.2 k Ω , $\pm 5\%$, $\frac{1}{2}$ W Composite
R204	203X6700-327	100 Ω , $\pm 5\%$, $\frac{1}{2}$ W Carbon	R233	340X2221-934	220 Ω , $\pm 5\%$, $\frac{1}{4}$ W, Carbon
R205	203X6700-421	270 Ω , $\pm 5\%$, $\frac{1}{2}$ W Carbon	R234	340X2820-934	82 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon
R206	203X6500-540	390 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon	R235	340X2820-934	82 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon
R207	340X2271-934	270 Ω , $\pm 5\%$, $\frac{1}{4}$ W, Carbon	R236	340X2820-934	82 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon
R208	203X6500-540	390 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon	R237	340X2471-934	470 Ω , $\pm 5\%$, $\frac{1}{4}$ W, Carbon
R209	340X2271-934	270 Ω , $\pm 5\%$, $\frac{1}{4}$ W, Carbon	R238	340X2471-934	470 Ω , $\pm 5\%$, $\frac{1}{4}$ W, Carbon
R210	203X6500-540	390 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon	R239	340X2471-934	470 Ω , $\pm 5\%$, $\frac{1}{4}$ W, Carbon
R211	340X2271-934	270 Ω , $\pm 5\%$, $\frac{1}{4}$ W, Carbon	R240	340X2471-934	470 Ω , $\pm 5\%$, $\frac{1}{4}$ W, Carbon
R214	203X6500-645	1 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon	R301	203X6500-508	270 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon
R215	203X6501-126	100 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon	R302	203X6500-863	8.2 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon
R216	203X6500-645	1 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon	R303	203X6500-863	8.2 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon
R217	203X6500-405	100 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon	R304	203X6500-724	2.2 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon
R218	203X6500-645	1 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon	R305	203X6500-842	6.8 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon
R219	203X6501-126	100 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon	R306	203X6003-201	7.5 k Ω , 2%, $\frac{1}{4}$ W Carbon
R220	203X6500-645	1 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon	R307	203X6500-825	5.6 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon
R221	203X6500-405	100 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon	R309	203X6500-965	22 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon
R222	203X6500-762	3.3 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon			
R224	203X6500-169	10 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon			
R225	203X6500-169	10 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon			
R226	203X6500-169	10 Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon			
R227	203X6501-044	47 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon			
R228	340X2152-934	1.5 k Ω , $\pm 5\%$, $\frac{1}{4}$ W Carbon			

Refer. No.	Wells-Gardner Part No.	Description	Refer. No.	Wells-Gardner Part No.	Description
R310	203X6500-988	39 k Ω , $\pm 5\%$, ¼ W Carbon	R383	203X9014-387	150 Ω , $\pm 5\%$, 1 W Metal Oxide
R311	203X9014-709	3.3 k Ω , $\pm 5\%$, 1 W Carbon	R384	203X6501-088	68 k Ω , $\pm 5\%$, ¼ W Carbon
R312	203X9014-741	4.7 k Ω , $\pm 5\%$, 1 W Metal Oxide	R385	340X2122-934	1.2 k Ω , $\pm 5\%$, ¼ W Carbon
R313	204X1527-528	470 Ω , $\pm 5\%$, 7 W Carbon	R389	340X5183-633	18 k Ω , $\pm 5\%$, 2 W Metal Oxide
R314	203X6500-481	220 Ω , $\pm 5\%$, ¼ W Carbon	R390	340X4222-633	2.2 k Ω , $\pm 5\%$, 1 W Metal Oxide
R315	203X6500-169	10 Ω , $\pm 5\%$, ¼ W Carbon	R391	340X4222-633	2.2 k Ω , $\pm 5\%$, 1 W, Metal Oxide
R317	203X6700-061	8.2 Ω , $\pm 5\%$, ½ W Carbon	R394	43X0478-001	680 Ω , $\pm 5\%$, 5 W, Wirewound
R318	203X6500-584	560 Ω , $\pm 5\%$, ¼ W Carbon	R502	203X6500-886	10 k Ω , $\pm 5\%$, ¼ W Carbon
R319	203X6500-645	1 k Ω , $\pm 5\%$, ¼ W Carbon	R503	43X0481-001	180 Ω , $\pm 5\%$, 25 W, Wirewound
R320	203X6501-002	33 k Ω , $\pm 5\%$, ¼ W Carbon	R504	203X9014-267	47 Ω , $\pm 5\%$, 1 W Metal Oxide
R321	203X6501-224	270 k Ω , $\pm 5\%$, ½ W Carbon	R505	203X6501-209	220 k Ω , $\pm 5\%$, ¼ W Carbon
R322	203X6500-886	10 k Ω , $\pm 5\%$, ¼ W Carbon	R506	204X1425-196	15 Ω , $\pm 5\%$, 5 W Wire-Wound
R351	340X2183-934	18 k Ω , $\pm 5\%$, ¼ W, Carbon	R507	203X5602-185	330 k Ω , $\pm 5\%$, ½ W Composite
R352	203X6500-785	3.9 k Ω , $\pm 5\%$, ¼ W Carbon	R601	▲ ★ 204X1625-058	3.3 Ω , $\pm 5\%$, 10 W Wire-Wound
R353	340X2393-934	39 k Ω , $\pm 5\%$, ¼ W, Carbon	R701	340X5074-633	4.7 Ω , $\pm 5\%$, 2 W, Metal Oxide
R354	340X2432-934	4.3 k Ω , $\pm 5\%$, ¼ W, Carbon	R702	203X6206-441	2.2 Ω , $\pm 5\%$, ½ W Carbon
R355	203X9205-143	6.8 k Ω , $\pm 5\%$, 3 W Metal Oxide	R705	340X3473-934	4.7 k Ω , $\pm 5\%$, ½ W, Carbon
R358	340X3683-934	68 k Ω , $\pm 5\%$, ½ W Carbon	R706	340X2273-934	27 k Ω , $\pm 5\%$, ¼ W, Carbon
R359	340X8222-934	8.2 k Ω , $\pm 5\%$, ¼ W, Carbon	VR201	204X2070-072	2 k Ω -B Semi-Fixed
R360	203X6500-561	470 Ω , $\pm 5\%$, ¼ W Carbon	VR301	204X2070-084	5 k Ω -B Semi-Fixed
R361	203X6500-886	10 k Ω , $\pm 5\%$, ¼ W Carbon	VR302	204X2070-084	5 k Ω -B Semi-Fixed
R362	203X9014-645	1.8 k Ω , $\pm 5\%$, 1 W Metal Oxide	VR303	204X2070-055	500 Ω -B Semi-Fixed
R363	★ 204X1450-516	3.9 k Ω , $\pm 5\%$, 5 W Metal Oxide	VR351	204X2070-072	2 k Ω -B Semi-Fixed
R364	203X6500-246	22 Ω , $\pm 5\%$, ¼ W Carbon	VR352	204X2070-072	10 k Ω -B Semi Fixed
R365	340X2183-934	18 k Ω , $\pm 5\%$, ¼ W Carbon	Capacitors		
R367	203X6500-886	10 k Ω , $\pm 5\%$, ¼ W Carbon	C201	203X0014-088	1000 μ F, 16 V, Electrolytic
R368	203X5602-185	330 k Ω , $\pm 5\%$, ½ W Composite	C202	202X7200-064	330 pF, 500 V, Ceramic
R369	203X5602-329	680 k Ω , $\pm 5\%$, ½ W Composite	C203	202X7200-043	220 pF, 500 V, Ceramic
R370	340X2223-934	22 k Ω , $\pm 5\%$, ¼ W, Carbon	C204	202X7200-043	220 pF, 500 V, Ceramic
R371	203X9014-584	1 k Ω , $\pm 5\%$, 1 W Metal Oxide	C205	203X0014-076	470 μ F, 16 V, Electrolytic
R372	203X9104-809	12 k Ω , $\pm 5\%$, 2 W Metal Oxide	C206	203X1810-149	0.1 μ F, 125 V, Mylar
R375	203X9014-724	3.9 k Ω , $\pm 5\%$, 1 W Carbon	C207	349X2232-109	.022 μ F, 100 V, Mylar
R376	203X9104-404	270 Ω , $\pm 5\%$, 2 W Metal Oxide	C301	203X0014-065	330 μ F, 50 V, Electrolytic
R377	203X6500-447	150 Ω , $\pm 5\%$, ¼ W Carbon	C302	203X1600-563	.022 μ F, 50 V, Mylar
R378	203X6500-886	10 k Ω , $\pm 5\%$, ¼ W Carbon	C303	203X0629-037	2.2 μ F, 50 V, Electrolytic
R379	203X6500-886	10 k Ω , $\pm 5\%$, ¼ W Carbon	C304	203X1600-366	.0068 μ F, 50 V, Mylar
R380	203X6500-865	8.2 k Ω , $\pm 5\%$, ¼ W Carbon	C306	203X0412-012	2.2 μ F, 16 V, Tantalum
R381	203X6500-724	2.2 k Ω , $\pm 5\%$, 1 W Metal Oxide	C307	203X1600-634	0.033 μ F, 50 V, Mylar
			C308	203X0025-163	2.2 μ F, 50 V, Electrolytic
			C309	203X1207-100	0.068 μ F, 100 V, Polypropylene

Refer. No.	Wells-Gardner Part No.	Description	Refer. No.	Wells-Gardner Part No.	Description
Semiconductors					
C310	203X0629-061	10 μ F, 100 V, Electrolytic	D203	201X2010-159	Diode, 1S2076-27
C311	203X0041-162	4.7 μ F, 160 V, Electrolytic	D204	201X2010-159	Diode, 1S2076-27
C312	202X7050-248	1000 pF, 500 V, Ceramic	D205	201X2010-159	Diode, 1S2076-27
C313	203X0040-068	100 μ F, 160 V, Electrolytic	D206	201X2010-159	Diode, 1S2076-27
C314	203X1201-096	0.039 μ F, 200 V, Polypropylene	D207	201X2010-159	Diode, 1S2076-27
C315	203X0629-023	1 μ F, 50 V, Electrolytic	D208	201X2010-159	Diode, 1S2076-27
C351	203X0629-023	1 μ F, 50 V, Electrolytic	D209	201X2010-159	Diode, 1S2076-27
C352	203X0619-045	47 μ F, 25 V, Electrolytic	D302	201X2010-159	Diode, 1S2076-27
C353	46X0528-024	0.0047 μ F, 33 V, Polystyrene	D303	201X2010-159	Diode, 1S2076-27
C354	203X0619-045	47 μ F, 25 V, Electrolytic	D304	201X2120-009	Diode, RH-1V
C355	203X1600-366	0.0068 μ F, 50 V, Mylar	D305	201X2120-009	Diode, RH-1V
C356	203X1130-287	0.0047 μ F, 50 V, Mylar	D306	201X2010-159	Diode, 1S2076-27
C359	202X8065-606	100 pF, 500 V, Ceramic	D307	201X2010-165	Diode, 1SS81
C360	202X7050-366	0.0033 μ F, 500 V, Ceramic	D501	201X3120-216	Diode, RM-1AV
C361	202X7050-483	0.01 μ F, 500 V, Ceramic	D502	201X3120-216	Diode, RM-1AV
C362	202X7203-032	0.01 μ F, 50 V, Ceramic	D503	201X3120-216	Diode, RM-1AV
C363	▲ ★ 46X0551-001	4300 pF, 1.5 kV, Polypropylene	D504	▲ ★ 201X3120-216	Diode, RM-1AV
C365	203X1201-265	0.33 μ F, 200 V, Polypropylene	D505	201X3120-216	Diode, RM-1AV
C366	203X0019-026	22 μ F, 25 V, Electrolytic	D506	201X3120-216	Diode, RM-1AV
C367	202X8065-162	6 pF, 500 V, Ceramic	D701	201X2130-234	Diode, RU-2V
C368	203X1100-858	0.1 μ F, 50 V	D702	201X2120-009	Diode, RH-1V
C369	203X1207-087	0.047 μ F, 100 V, Polypropylene	D705	66X0075-001	Diode, 1N4005
C370	80X0098-048	5 pF, 2 kV, Ceramic, \pm 20%, NPO	Q201	200X3181-523	Transistor, (NPN) 2SC1815GR
C372	203X1207-125	0.1 μ F, 100 V, Polypropylene	Q202	200X3181-523	Transistor, (NPN) 2SC1815GR
C373	203X0029-021	1 μ F, 50 V, Electrolytic	Q203	200X4056-260	Transistor, (PNP) 2SA562-Y-TM
C380	202X7200-087	470 pF, 500 V, Ceramic	Q204	200X4056-260	Transistor, (PNP) 2SA562-Y-TM
C381	80X0099-006	470 pF, 500 V, Ceramic	Q205	200X4056-260	Transistor, (PNP) 2SA562-Y-TM
C385	46X0536-036	1000 pF, 1.6 kV, Polypropylene	Q206	200X3181-523	Transistor, (NPN) 2SC1815GR
C389	45X0525-008	0.22 μ F, 25 V, Tantalum	Q207	200X3181-523	Transistor, (NPN) 2SC1815GR
C391	46X0544-005	0.15 μ F, 100 V, Polypropylene	Q208	200X3181-523	Transistor, (NPN) 2SC1815GR
C501	▲ ★ 203X1810-149	0.1 μ F, 125 V, Mylar	Q209	200X3181-523	Transistor, (NPN) 2SC1815GR
C502	▲ ★ 202X7050-282	1500 pF, 500 V, Ceramic	Q210	200X3181-523	Transistor, (NPN) 2SC1815GR
C503	▲ ★ 202X7810-214	2200 pF, 125 V, Ceramic	Q301	200X3181-523	Transistor, (NPN) 2SC1815GR
C504	▲ ★ 202X7810-214	2200 pF, 125 V, Ceramic	Q302	200X3207-306	Transistor, (NPN) 2SC2073LBGL2
C505	203X0220-075	560 μ F, 200 V, Electrolytic	Q303	200X3207-306	Transistor, (NPN) 2SC2073LBGL2
C506	203X0040-034	22 μ F, 160 V, Electrolytic	Q351	200X3248-217	Transistor, (NPN) 2SC2482BK
C507	203X0041-057	47 μ F, 160 V, Electrolytic	Q352	86X0178-001	Transistor (NPN), 2SD870
C701	203X0019-092	1000 μ F, 25 V, Electrolytic	ZD301	66X0040-031	Diode, Zener 24 V, \pm 3%, $\frac{1}{2}$ W
C702	203X0634-061	10 μ F, 100 V, Electrolytic	IC301	200X2300-033	Integrated Circuit, HA 11423
C703	202X7050-248	1000 pF, 500 V, Ceramic	IC501	▲ ★ 86X0179-001	Integrated Circuit, STR380
C705	46X0544-004	0.012 μ F, 100 V, Polypropylene	ZD202	66X0040-019	Diode, Zener, 3.9 V, \pm 5%, $\frac{1}{2}$ W
C706	45X0566-003	22 μ F, 100 V, Electrolytic			

Refer. No.		Wells-Gardner Part No.	Description
Transformers and Coils			
L352	★	9A2838-002	Horizontal Size Coil
L353		9A2813-002	Linearity Coil
L701		611X0005-005	Degaussing Coil
T351		202X1300-080	Horizontal Drive Transformer
T352	▲ ★	200X9720-301	HV Unit, M-11
Miscellaneous			
F501	▲ ★	204X7120-073	Fuse, 4 Amp. 125V
J402		206X5008-632	Receptacle, W Wire 3P-M-BG
P201		204X9600-466	Plug, PWB 3P-J
P202		204X9601-477	Plug, PWB 6P-Q
P401		204X9600-298	Plug, PWB 4P-B
P501		204X9600-249	Plug, PWB 2P-B
P601		204X9600-304	Plug, PWB 4P-C
TH501		201X0100-112	Thermistor
Final Assembly Parts			
	▲ ★	88X0217-506	Cathode-Ray Tube, Rauland Type-M48AAWOOX
	▲ ★	9A2843-001	Deflection Yoke
		291X5004-262	Automatic Degaussing Coil Unit
		205X9800-158	Purity/Convergence Assembly

Neck Board

Refer. No.	Wells-Gardner Part No.	Description	Refer. No.	Wells-Gardner Part No.	Description
Resistors					
R401	203X6000-729	220 Ω , $\pm 5\%$ $\frac{1}{4}$ W Carbon	R416	203X9105-154	2.2 Ω , $\pm 5\%$ 2 W Metal Oxide
R402	203X6500-540	390 Ω , $\pm 5\%$ $\frac{1}{4}$ W Carbon	R419	203X6500-741	2.7 k Ω , $\pm 5\%$ $\frac{1}{4}$ W Carbon
R403	203X6000-661	820 Ω , $\pm 5\%$ $\frac{1}{4}$ W Carbon	R420	203X6500-741	2.7 k Ω , $\pm 5\%$ $\frac{1}{4}$ W Carbon
R404	203X6000-729	220 Ω , $\pm 5\%$ $\frac{1}{4}$ W Carbon	R421	203X6500-741	2.7 k Ω , $\pm 5\%$ $\frac{1}{4}$ W Carbon
R405	203X6500-540	390 Ω , $\pm 5\%$ $\frac{1}{4}$ W Carbon	VR401	204X2115-014	500 Ω , -B Semi-Fixed
R406	203X6000-661	820 Ω , $\pm 5\%$ $\frac{1}{4}$ W Carbon	VR402	204X2115-014	500 Ω , -B Semi-Fixed
R407	203X6000-729	47 Ω , $\pm 5\%$ $\frac{1}{4}$ W Carbon	VR403	204X2115-006	5 k Ω , -B Semi-Fixed
R408	203X6000-998	270 Ω , $\pm 5\%$ $\frac{1}{4}$ W Carbon	VR404	204X2115-006	5 k Ω , -B Semi-Fixed
R409	203X6000-661	820 Ω , $\pm 5\%$ $\frac{1}{4}$ W Carbon	VR405	204X2115-006	5 k Ω , -B Semi-Fixed
R410	340X5682-633	6.8 k Ω , $\pm 5\%$, 2 W, Metal Oxide	Capacitors		
R411	340X5682-633	6.8 k Ω , $\pm 5\%$, 2 W, Metal Oxide	C401	80X0099-023	390 pF, 500 V, Ceramic
R412	340X5682-633	6.8 k Ω , $\pm 5\%$, 2 W, Metal Oxide	C402	80X0099-023	390 pF, 500 V, Ceramic
R413	203X6000-998	2.7 k Ω , $\pm 5\%$ $\frac{1}{2}$ W Composite	C403	80X0099-023	390 pF, 500 V, Ceramic
R414	203X6000-998	2.7 k Ω , $\pm 5\%$ $\frac{1}{2}$ W Composite	C404	202X7050-282	1500 pF, 1.5 kV, Ceramic
R415	203X6000-998	2.7 k Ω , $\pm 5\%$ $\frac{1}{2}$ W Composite	C405	202X7050-483	0.01 μ F, 500 V, Ceramic
			Semiconductors		
			Q401	200X3206-800	Transistor, (NPN) 2SC2068LB

Refer. No.	Wells-Gardner Part No.	Description
Q402	200X3206-800	Transistor, (NPN) 2SC2068LB
Q403	200X3206-800	Transistor, (NPN) 2SC2068LB
Miscellaneous		
J401	206X5009-296	Receptacle, W Wire 4P-E
P402	204X9600-254	Plug, PWB 3P-A
P403	204X9600-981	Plug, 1-Pin
P701	204X9601-020	Plug, PWB 4P-E
	204X9301-255	CRT Socket

Vertical Position Board (P344)

Refer. No.	Wells-Gardner Part No.	Description
Resistors		
VR901	40X0645-001	25 k Ω Vert. Position Control
Semiconductors		
Q901	86X0127-001	Transistor, (NPN) TPS98

Auto Protect Board (P390)

Refer. No.	Wells-Gardner Part No.	Description
Resistors		
R100	340X2330-934	33 Ω , $\pm 5\%$, $\frac{3}{4}$ W, Carbon
R101	340X2101-934	100 Ω , $\pm 5\%$, $\frac{3}{4}$ W, Carbon
R102	340X2102-934	1 k Ω , $\pm 5\%$, $\frac{3}{4}$ W, Carbon
R103	340X2223-934	22 k Ω , $\pm 5\%$, $\frac{3}{4}$ W, Carbon
R104	40X0639-007	5 k Ω Control
Capacitors		
C100	45X0560-017	47 μ F, 25 V, Electrolytic
Semiconductors		
Q100	86X0114-001	Transistor (PNP), 2N3906
Q101	86X0127-001	Transistor (NPN), TPS 98
ZD100	66X0040-032	Diode, 13 V, $\pm 3\%$, $\frac{1}{2}$ W Zener

Typical DC Voltages With Input Signal

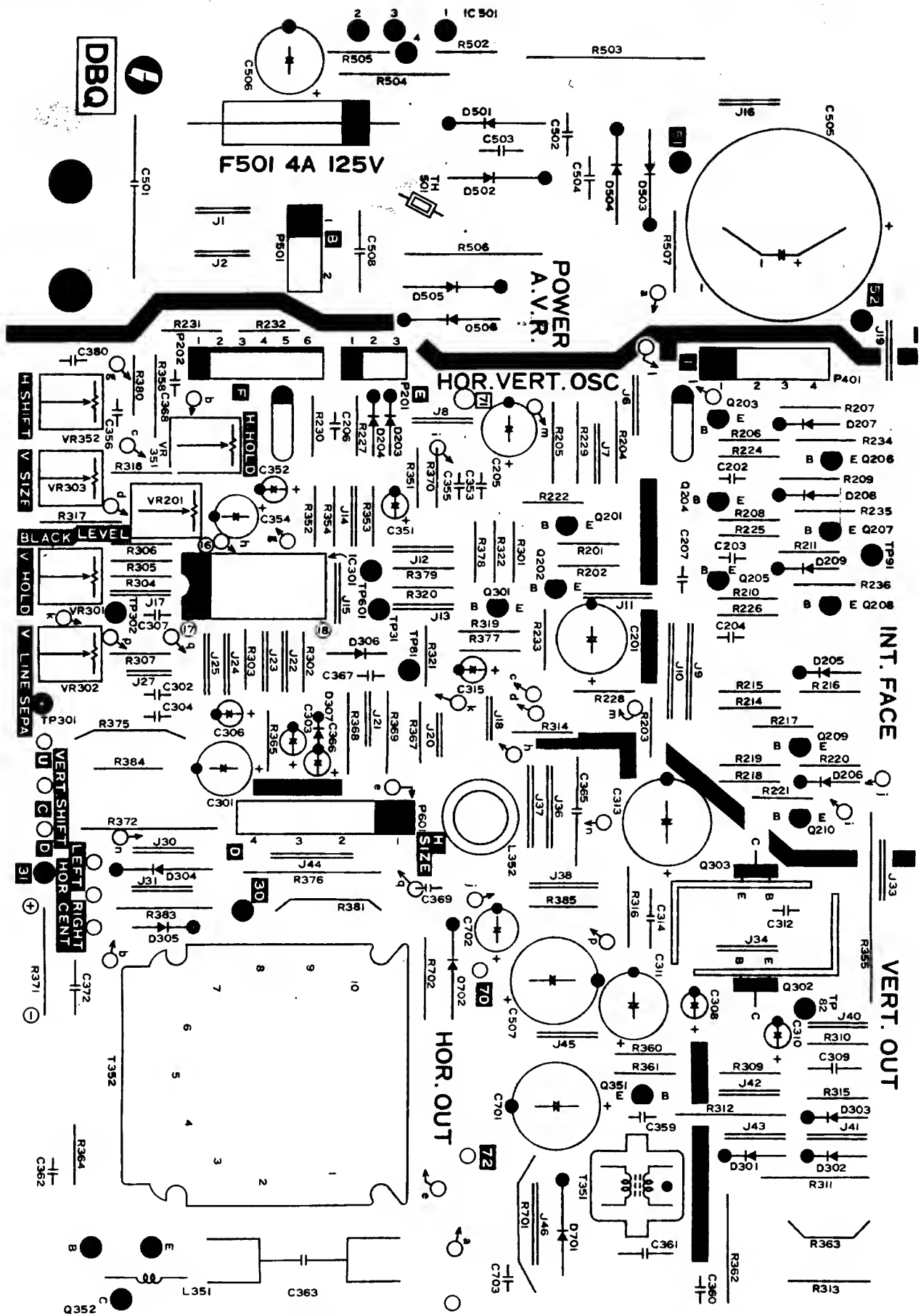
Transistor Number	Collector	Transistor Base	Emitter
Q201	8.1	0.43	0.36
Q202	9.8	8.1	9.3
Q203	0.0	0.35	1.0
Q204	0.0	0.35	1.0
Q205	0.0	0.35	1.0
Q206	9.7	5.5	4.8
Q207	9.7	5.5	4.8
Q208	9.7	5.5	4.8
Q209	15.4	-0.30	0.01
Q210	14.0	0.31	0.17
Q301	15.5	4.7	4.2
Q302	79.0	37.8	37.7
Q303	37.0	0.51	0.0
Q351	41.4	0.41	0.0
Q352	Do not measure	-0.03	0.0
Q401	88.3	8.5	8.4
Q402	88.3	8.5	8.4
Q403	88.3	8.5	8.4
Q901	34.6	17.5	16.9

I. C. 301

Pin No.	Voltage
1	1.16
2	4.0
3	6.8
4	3.9
5	12.1
6	4.1
7	4.1
8	1.9
9	12.2
10	14.2
11	3.6
12	7.9
13	6.8
14	12.8
15	1.52
16	0.0
17	0.83
18	0.0

I. C. 501

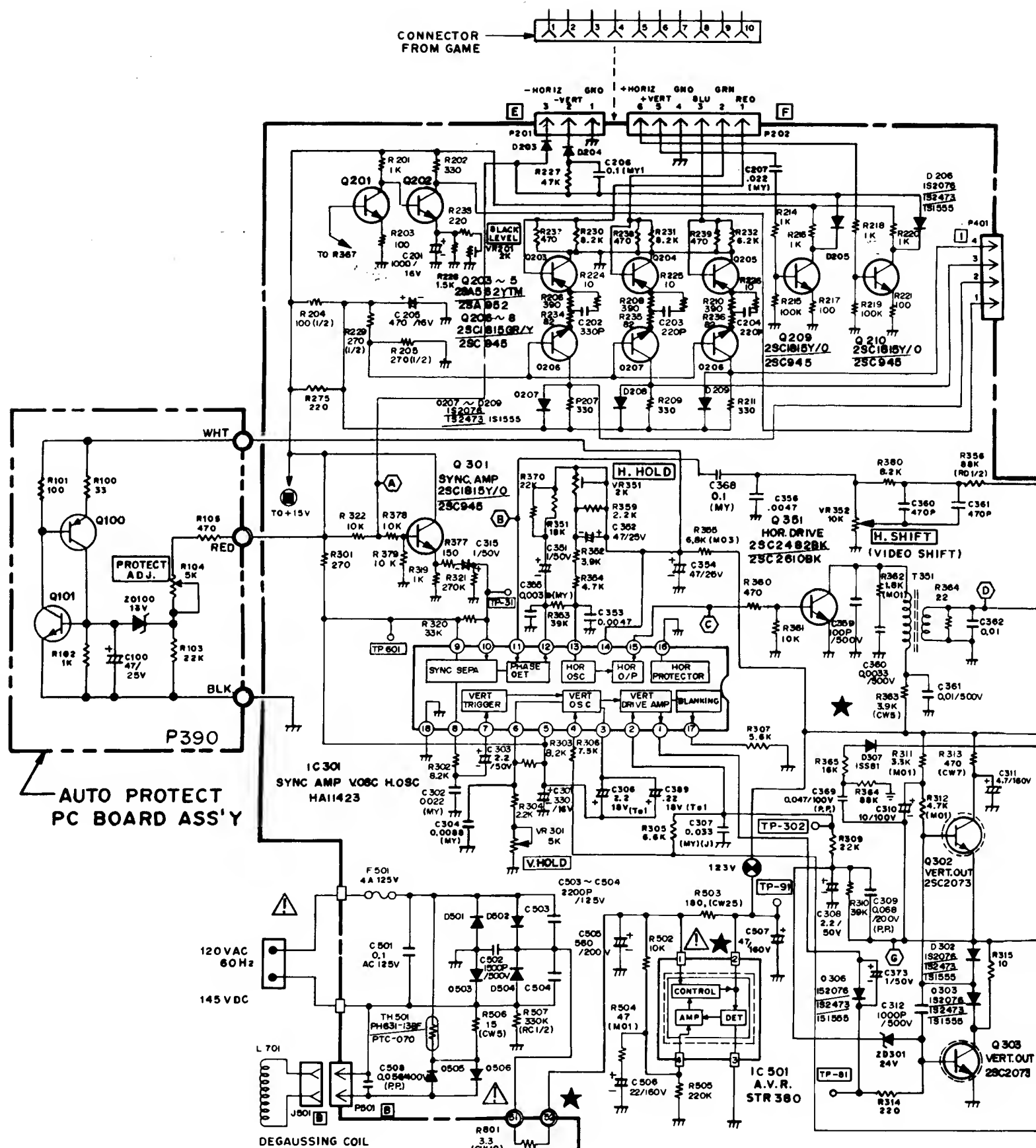
Pin No.	Voltage
1	159
2	123
3	0
4	125



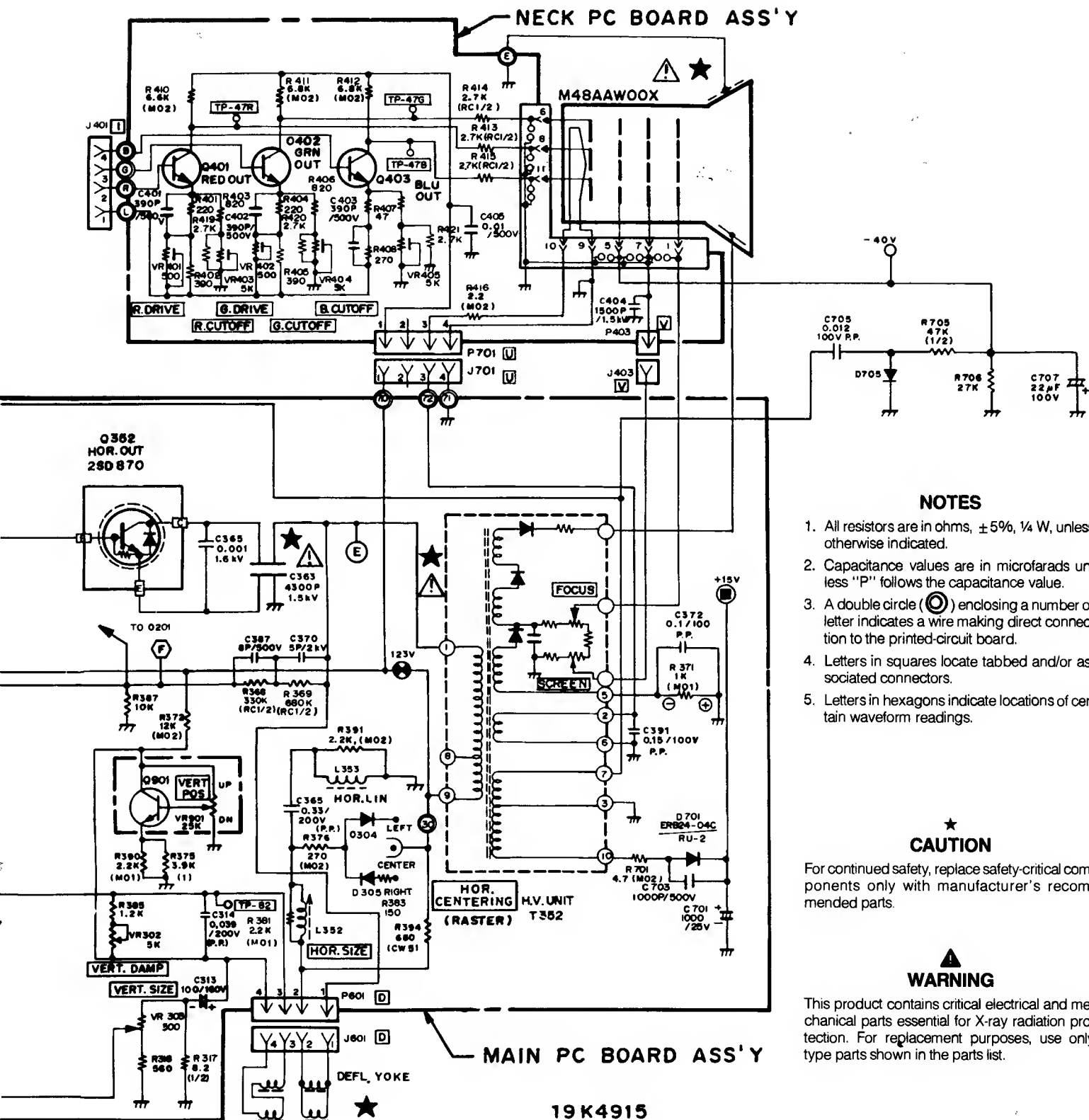
Main PC Board (Component Side)



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Schematic Diagram



NOTES

1. All resistors are in ohms, $\pm 5\%$, $\frac{1}{4}$ W, unless otherwise indicated.
2. Capacitance values are in microfarads unless "P" follows the capacitance value.
3. A double circle (\odot) enclosing a number or letter indicates a wire making direct connection to the printed-circuit board.
4. Letters in squares locate tabbed and/or associated connectors.
5. Letters in hexagons indicate locations of certain waveform readings.

★
CAUTION

For continued safety, replace safety-critical components only with manufacturer's recommended parts.

▲
WARNING

This product contains critical electrical and mechanical parts essential for X-ray radiation protection. For replacement purposes, use only type parts shown in the parts list.